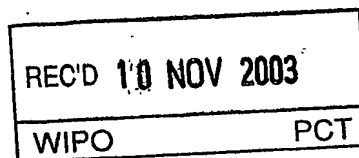




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19 APR 2005

INVESTOR IN PEOPLE #2

The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

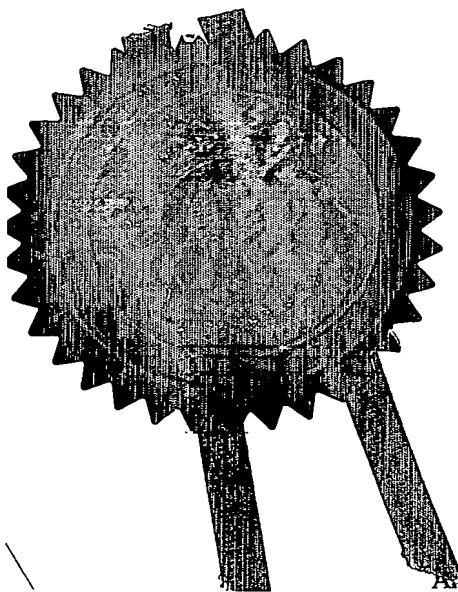


I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Dated 18 July 2003

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The  
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THE PATENT OFFICE

30 OCT 2002

**Request for grant of a patent**

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office  
Cardiff Road  
Newport  
Gwent NP23 5RH

1.	Your reference	GB Case	EL/2-22773/P1	30OCT02 E759714-1 003049
2.	Patent application number (The Patent Office will fill in this part)	0225244.3 1700 0.00-0225244.3		
3.	Full name, address and postcode of the or of each applicant (underline all surnames)	Ciba Specialty Chemicals Holding Inc Klybeckstrasse 141 4057 Basel Switzerland		
	Patent ADP number (if you know it)	08468753001 ✓		
	If the applicant is a corporate body, give the country/state of its incorporation	Switzerland		
4.	Title of invention	ELECTROLUMINESCENT DEVICE		
5.	Name of your agent (if you have one) "Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	Ciba Specialty Chemicals Holding Inc Patents Department PO Box 38 Cleckheaton Road Low Moor Bradford West Yorkshire BD12 0JZ		
	Patents ADP number (if you know it)	08192080001 ✓		
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day/month/year)
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application		Date of filing (day/month/year)
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. (see note (d))	YES		

EL/2-22773/P1

## ELECTROLUMINESCENT DEVICE

The present invention relates to organo-electroluminescent (EL) devices, in particular EL devices that comprise durable, blue-emitting organo-electroluminescent layers. The organo-electroluminescent layers comprise certain organic compounds containing one or more pyrimidine moieties.

### Background

Progress has been made towards developing organic-based electroluminescent devices suitable for full color displays. Generally, an EL device is comprised of a light-emitting layer or layers and a pair of facing electrodes sandwiching the light-emitting layer(s). Application of an electric field between the electrodes results in the injection of electrons and holes to the system, resulting in the release of energy as light.

However, organo EL devices have not been developed that have suitable stability under continuous operation. In particular, there remains a need for blue-emitting, stable organo EL devices.

U.S. Pat. No. 5,104,740 teaches an electroluminescent element that comprises a fluorescent layer containing a coumarinic or azacoumarinic derivative and a hole transport layer, both made of organic compounds and laminated on top of the other.

U.S. Pat. No. 6,280,859 discloses certain polyaromatic organic compounds for use as a light-emitting material in organo-electroluminescent devices.

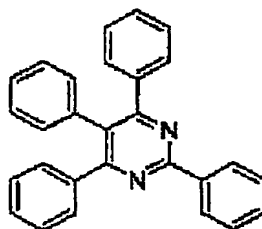
U.S. Pat. No. 5,116,708 is aimed at a hole transport material for EL devices.

WO98/04007 and EP-A-1013740 relate to an electroluminescent arrangement with the electron-conducting layer containing one or more compounds comprising triazine as basic substance.

EP-A-1013740 discloses the use of triazine compounds in EL devices.

WO02/02714 relates to electroluminescent iridium compounds with fluorinated phenylpyridines, phenylpyrimidines, and phenylquinolines and devices made with such compounds.

US-A-5,077,142 relates to EL devices comprising a number of organic compounds as light



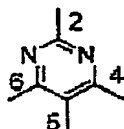
emitting material. A pyrimidine moiety, , is listed among a long list of possible organic compounds.

Certain organic compounds containing one or more pyrimidine moieties are found to be suitable for use in organo-electroluminescent devices. In particular, certain pyrimidine derivatives are suitable blue emitters with good durability.

#### Detailed Disclosure

The present invention is aimed at an electroluminescent device comprising an organic light-emitting layer that contains at least one blue-emitting organic compound containing one or more pyrimidine moieties.

Accordingly the present invention relates to an electroluminescent device comprising an anode, a cathode and one or a plurality of organic compound layers sandwiched therebetween, in which said organic compound layers comprise an organic compound containing one or more pyrimidine moieties:

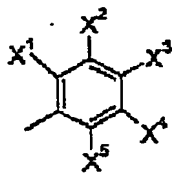


For example, the present organic compounds comprise one, two, three or more pyrimidine moieties, including oligomers and polymers. It is understood that the open valences in the pyrimidine moiety represents a covalent bond that is not limited in its substitution.

In general, the organic compound or compounds emit light below about 520 nm, in particular between about 380 nm and about 520 nm.

The organic compound or compounds have a NTSC coordinate of between about (0.12, 0.05) and about (0.16, 0.10), preferably a NTSC coordinate of about (0.14, 0.08).

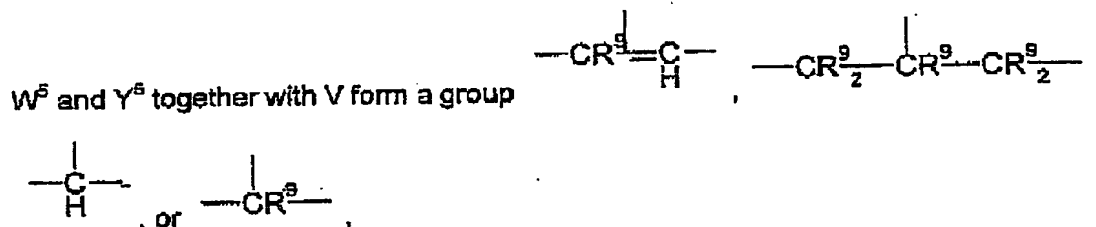
X is  $C_6-C_{24}$ aryl or  $C_2-C_{24}$ heteroaryl, which can be substituted or unsubstituted, in particular



, H;  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl;  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $-SR^5$ ;  $-NR^5R^6$ ; wherein the groups  $V^1$  to  $V^6$ ,  $W^1$  to  $W^5$ ,  $X^1$  to  $X^5$  and  $Y^1$  to  $Y^5$  are independently of each other H; halogen,  $C_6-C_{18}$ aryl;  $C_6-C_{18}$ aryl which is substituted by G;  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_7-C_{18}$ alkylaryl;  $C_7-C_{18}$ alkylaryl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl;  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $-SR^5$ ;  $-NR^5R^6$ ;  $C_2-C_{18}$ heteroaryl;  $C_2-C_{18}$ heteroaryl which is substituted by L;  $-SOR^4$ ;  $-SO_2R^4$ ;  $-COR^6$ ;  $-COOR^7$ ;  $-CONR^5R^6$ ;  $C_4-C_{18}$ cycloalkyl;  $C_4-C_{18}$ cycloalkyl which is substituted by E and/or interrupted by D;  $C_4-C_{18}$ cycloalkenyl;  $C_4-C_{18}$ cycloalkenyl which is substituted by E and/or interrupted by D;

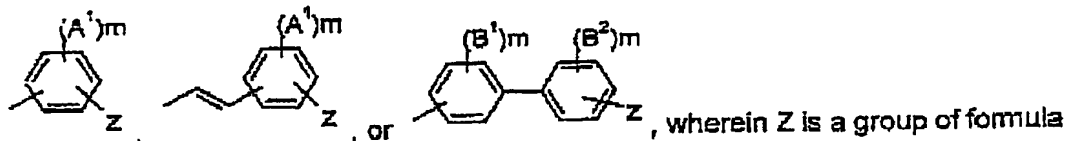
or

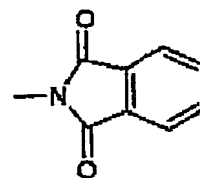
$W^2$  or  $Y^5$  together with V form a group  $-CR^9$ ,  $-CR^9_2$ ,  $-C(=O)CR^9$ ,  $-C(=O)-$ , or  $-CR^9=CR^9-$ , or



wherein  $R^9$  is H;  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is interrupted by  $-O-$ ,  $C_6-C_{18}$ aryl;  $C_6-C_{18}$ aryl which is substituted by  $C_1-C_{18}$ alkyl, or  $C_1-C_{18}$ alkoxy, or one of the substituents

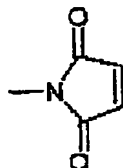
$V^1$  to  $V^6$ ,  $W^1$  to  $W^5$ ,  $X^1$  to  $X^5$ , or  $Y^1$  to  $Y^5$  is a group of the formula  $-Z$ ,  $-Ar-Z$ , wherein Ar is  $C_6-C_{24}$ aryl or  $C_6-C_{24}$ heteroaryl, which can be substituted, in particular





or

$R^5$  and  $R^6$  together form a five or six membered ring, in particular



$R^7$  is H;  $C_6-C_{18}$ aryl;  $C_6-C_{18}$ aryl which is substituted by  $C_1-C_{18}$ alkyl,  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is interrupted by  $-O-$ ;

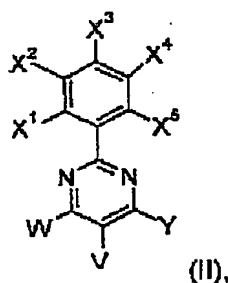
$R^8$  is H;  $C_6-C_{18}$ aryl;  $C_6-C_{18}$ aryl which is substituted by  $C_1-C_{18}$ alkyl,  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is interrupted by  $-O-$ .

or two substituents selected from  $V^1$  to  $V^5$ ,  $W^1$  to  $W^5$ ,  $X^1$  to  $X^5$ ,  $Y^1$  to  $Y^5$  which are in neighborhood to each other form a five to seven membered ring.

Preferably at least one, more preferably at least two, most preferably at least three of the groups V, W, X and Y are  $C_6-C_{24}$ aryl or  $C_6-C_{24}$ heteroaryl, which can be substituted.

Preferred are compounds of formula I, wherein at least one of the substituents  $Y^1$  to  $Y^5$  is different from H, at least one of the substituents  $W^1$  to  $W^5$  is different from H; at least one of the substituents  $X^1$  to  $X^5$  is different from H, and/or at least one substituent  $V^1$  to  $V^5$  is different from hydrogen.

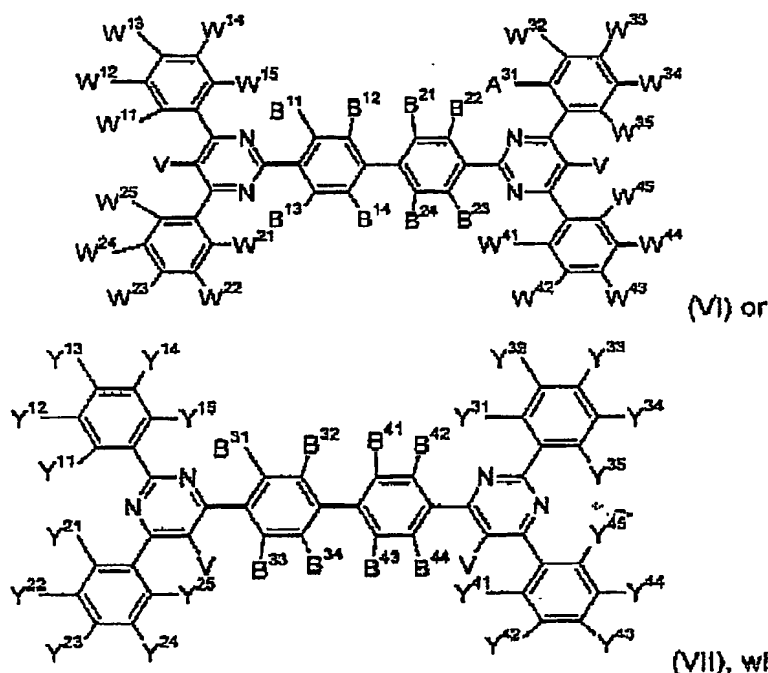
Preferably the electroluminescent device comprises pyrimidine compounds of formula II to VI:



(II),

wherein V, W, Y and  $X^1$  to  $X^5$  are as defined above;

9

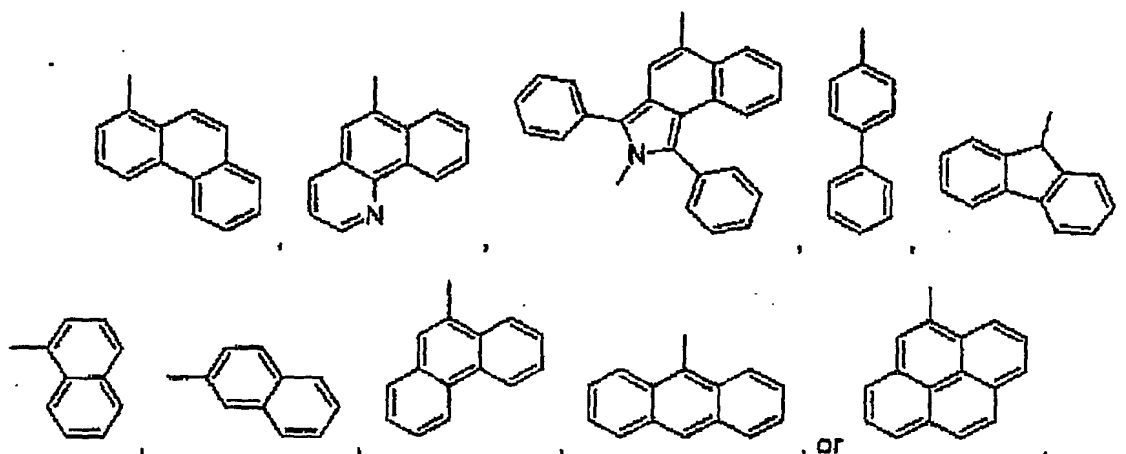


W<sup>11</sup> to W<sup>15</sup>, W<sup>21</sup> to W<sup>25</sup>, W<sup>31</sup> to W<sup>35</sup>, W<sup>41</sup> to W<sup>45</sup>, Y<sup>11</sup> to Y<sup>15</sup>, Y<sup>21</sup> to Y<sup>25</sup>, Y<sup>31</sup> to Y<sup>35</sup> and Y<sup>41</sup> to Y<sup>45</sup> are independently of each other H; C<sub>6</sub>-C<sub>18</sub>aryl; C<sub>6</sub>-C<sub>18</sub>aryl which is substituted by G; C<sub>1</sub>-C<sub>18</sub>alkyl; C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or interrupted by D; C<sub>7</sub>-C<sub>18</sub>alkylaryl; C<sub>7</sub>-C<sub>18</sub>alkylaryl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkenyl; C<sub>2</sub>-C<sub>18</sub>alkenyl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkynyl; C<sub>2</sub>-C<sub>18</sub>alkynyl which is substituted by E and/or interrupted by D; C<sub>1</sub>-C<sub>18</sub>alkoxy, C<sub>1</sub>-C<sub>18</sub>alkoxy which is substituted by E and/or interrupted by D; -SR<sup>5</sup>; -NR<sup>5</sup>R<sup>5</sup>; C<sub>2</sub>-C<sub>18</sub>heteroaryl; C<sub>2</sub>-C<sub>18</sub>heteroaryl which is substituted by L; -SOR<sup>4</sup>; -SO<sub>2</sub>R<sup>4</sup>; -COR<sup>8</sup>; -COOR<sup>7</sup>; -CONR<sup>5</sup>R<sup>5</sup>; C<sub>4</sub>-C<sub>18</sub>cycloalkyl; C<sub>4</sub>-C<sub>18</sub>cycloalkyl which is substituted by E and/or interrupted by D; C<sub>4</sub>-C<sub>18</sub>cycloalkenyl; C<sub>4</sub>-C<sub>18</sub>cycloalkenyl which is substituted by E and/or interrupted by D;

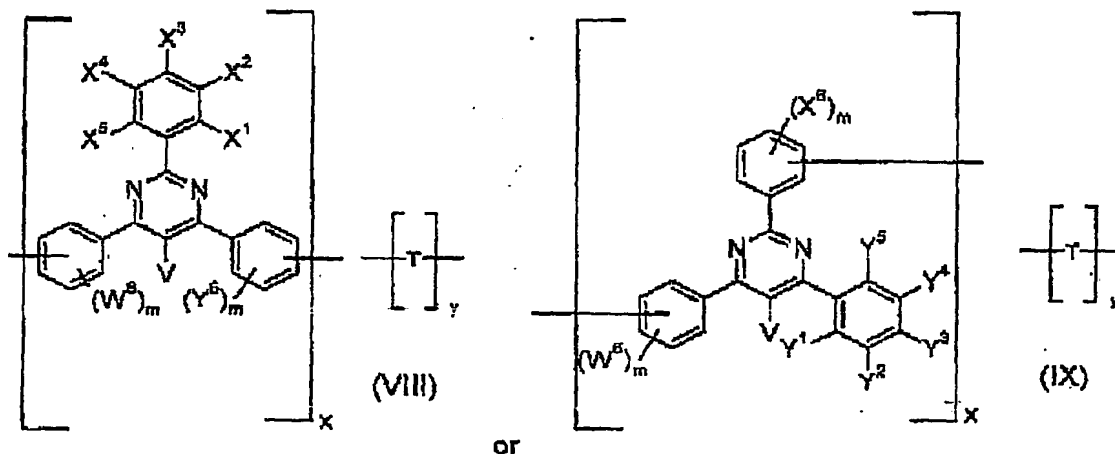
V is H; C<sub>6</sub>-C<sub>18</sub>aryl; C<sub>6</sub>-C<sub>18</sub>aryl which is substituted by G; C<sub>1</sub>-C<sub>18</sub>alkyl; C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or interrupted by D; C<sub>7</sub>-C<sub>18</sub>alkylaryl; C<sub>7</sub>-C<sub>18</sub>alkylaryl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkenyl; C<sub>2</sub>-C<sub>18</sub>alkenyl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkynyl; C<sub>2</sub>-C<sub>18</sub>alkynyl which is substituted by E and/or interrupted by D; C<sub>1</sub>-C<sub>18</sub>alkoxy, C<sub>1</sub>-C<sub>18</sub>alkoxy which is substituted by E and/or interrupted by D; -SR<sup>5</sup>; or -NR<sup>5</sup>R<sup>5</sup>; C<sub>2</sub>-C<sub>18</sub>heteroaryl; C<sub>2</sub>-C<sub>18</sub>heteroaryl which is substituted by L; -SOR<sup>4</sup>; -SO<sub>2</sub>R<sup>4</sup>; -COR<sup>8</sup>; -COOR<sup>7</sup>; -CONR<sup>5</sup>R<sup>5</sup>; C<sub>4</sub>-C<sub>18</sub>cycloalkyl; C<sub>4</sub>-C<sub>18</sub>cycloalkyl which is substituted by E and/or interrupted by D; C<sub>4</sub>-C<sub>18</sub>cycloalkenyl; C<sub>4</sub>-C<sub>18</sub>cycloalkenyl which is substituted by E and/or interrupted by D;

B<sup>11</sup> to B<sup>14</sup>, B<sup>21</sup> to B<sup>24</sup>, B<sup>31</sup> to B<sup>34</sup> and B<sup>41</sup> to B<sup>44</sup> are independently of each other H; C<sub>6</sub>-C<sub>18</sub>aryl; C<sub>6</sub>-C<sub>18</sub>aryl which is substituted by G; C<sub>1</sub>-C<sub>18</sub>alkyl; C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or

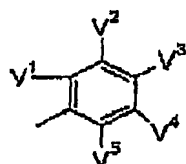
11



In addition, the organic compound can also be a polymer, comprising the following units:

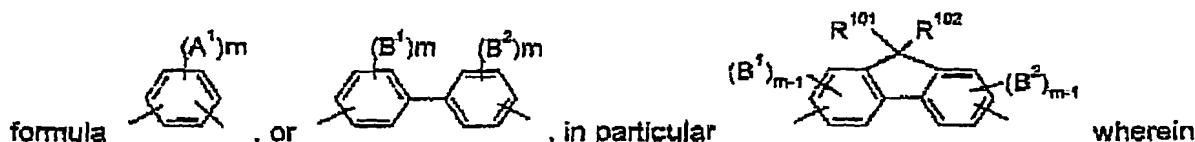


wherein  $x$  is chosen in the range of from 0.005 to 1, preferably from 0.01 to 1, and  $y$  from 0.995 to 0, preferably 0.99 to 0, and wherein  $x + y = 1$ ,  $V$  is a group of the formula



$H$ ,  $C_1$ - $C_{18}$ alkyl;  $C_1$ - $C_{18}$ alkyl which is substituted by  $E$  and/or interrupted by  $D$ ;  $C_2$ - $C_{18}$ alkenyl;  $C_2$ - $C_{18}$ alkenyl which is substituted by  $E$  and/or interrupted by  $D$ ;  $C_2$ - $C_{18}$ alkynyl;  $C_2$ - $C_{18}$ alkynyl which is substituted by  $E$  and/or interrupted by  $D$ ;  $C_1$ - $C_{18}$ alkoxy;  $C_1$ - $C_{18}$ alkoxy which is substituted by  $E$  and/or interrupted by  $D$ ;  $-SR^5$ ; or  $-NR^5R^6$ ; and

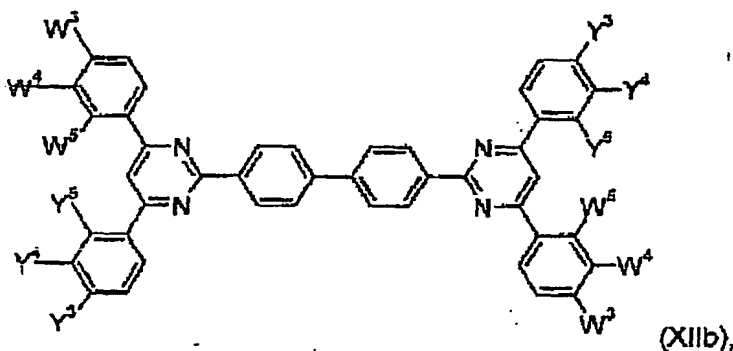
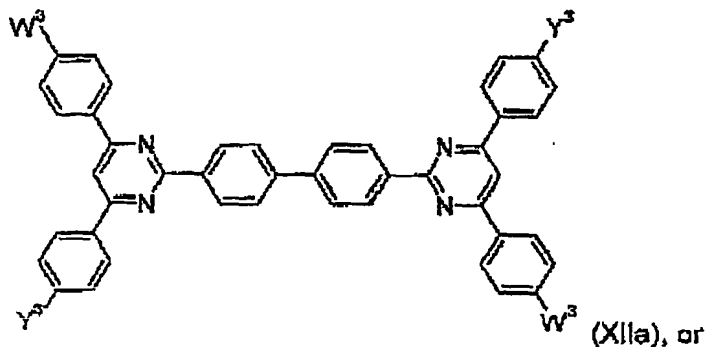
$T$  is  $C_6$ - $C_{24}$ -aryl or  $C_6$ - $C_{24}$ -heteroaryl, which can be substituted, in particular a group of the





13

$Y^3$  is H,  $C_1-C_8$ alkyl, or  $C_1-C_8$ alkoxy, wherein  $n_1$  is an integer of 1 to 4 and X is –  
 $O-(CH_2)_{m_1}CH_3$ ,  $-OC(O)-(CH_2)_{m_1}CH_3$ ,  $-C(O)-O-C_1-C_8$ alkyl, wherein  $m_1$  is an integer of 0 to 5;



wherein  $W^3$  and  $W^4$  are independently of each other H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy,

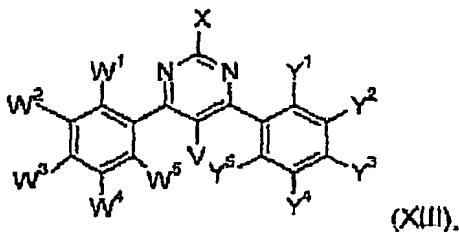
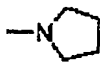
$Y^3$  and  $Y^4$  are independently of each other H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy, wherein  $R^{103}$  and  $R^{104}$  are independently of each other H, or  $C_1-C_8$ alkyl.

$W^5$  is H,  $C_1-C_8$ alkyl, or  $O(CH_2)_{n_1}-X$ ,

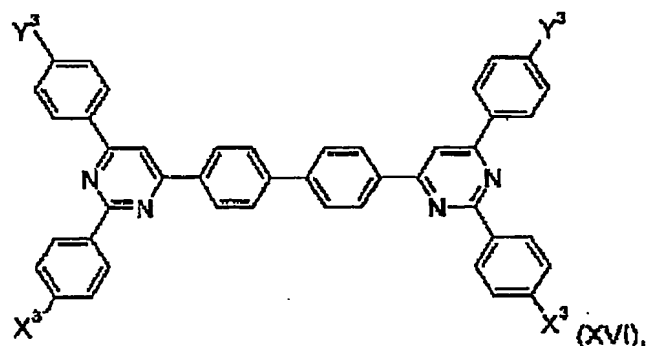
$Y^6$  is H,  $C_1-C_8$ alkyl, or  $O(CH_2)_{n_1}-X$ ,

wherein  $n_1$  is an integer of 1 to 5 and X is  $-O-(CH_2)_{m_1}CH_3$ ,  $-OC(O)-(CH_2)_{m_1}CH_3$ ,  $-C(O)-O-C_1-C_8$ alkyl,  $-NR^{103}R^{104}$ , wherein  $m_1$  is an integer of 0 to 5 and  $R^{103}$  and  $R^{104}$  are independently of each other H, or  $C_1-C_8$ alkyl, or  $R^{103}$  and  $R^{104}$  together form a five or six membered

heterocyclic ring, in particular

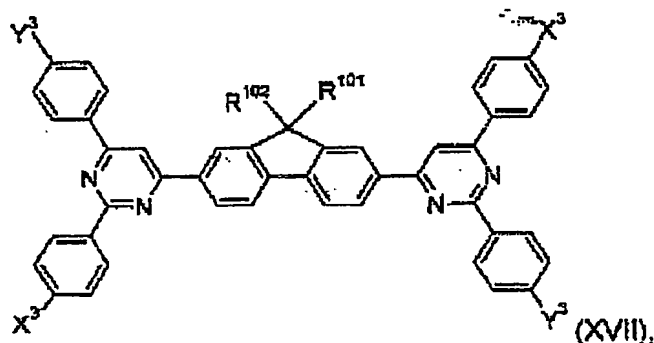


15



wherein  $Y^3$  is H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy,

$X^3$  is H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy, wherein  $R^{103}$  and  $R^{104}$  are independently of each other H, or  $C_1-C_8$ alkyl;

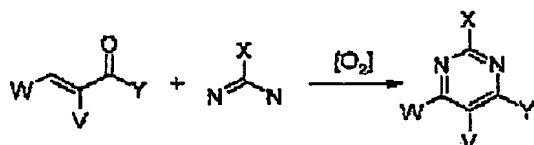


$Y^3$  is H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy,

$X^3$  is H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy, wherein  $R^{103}$  and  $R^{104}$  are independently of each other H, or  $C_1-C_8$ alkyl,  $R^{101}$  and  $R^{102}$  are independently of each other H,  $C_1-C_8$ alkyl, phenyl, or  $C_5-C_7$ cycloalkyl, in particular cyclohexyl;

The present pyrimidine compounds are known or can be prepared according to or analogous to known procedures. The present pyrimidine compounds are for instance derivatives of known hydroxyphenyl pyrimidine compounds: US-A-3,442,898, US-A-5,597,854 and US-A-5,753,729, the relevant parts of which are hereby incorporated by reference. The present pyrimidine compounds can for instance be prepared according to or analogous to the following procedures:

Suzuki aryl-aryl cross coupling reaction (Chem. Commun., 2002, 874 – 875); DE-A-3001188, J. Org. Chem. Vol. 36, 1971, 3382-3385:



17

E-T-E,

or -in case  $R^{100}$  is not halogen -

Hal-T-Hal,

wherein Hal stands for halogen, preferably for bromo,

wherein T is  $C_6$ - $C_{24}$ -aryl or  $C_5$ - $C_{24}$ -heteroaryl, which can be substituted (see for example US-A-6,451,459 or DE-A-19651439).

Preferably, the reaction is carried out in the presence of an organic solvent, such as an aromatic hydrocarbon or a usual polar organic solvent, such as benzene, toluene, xylene, tetrahydrofuran, or dioxane, or mixtures thereof, most preferred toluene. Usually, the amount of the solvent is chosen in the range of from 1 to 10 l per mol of boronic acid derivative. Also preferred, the reaction is carried out under an inert atmosphere such as nitrogen, or argon.

Further, it is preferred to carry out the reaction in the presence of an aqueous base, such as an alkali-metal hydroxide or carbonate such as NaOH, KOH,  $Na_2CO_3$ ,  $K_2CO_3$ ,  $Cs_2CO_3$  and the like, preferably an aqueous  $K_2CO_3$  solution is chosen. Usually, the molar ratio of the base to compound III is chosen in the range of from 0.5:1 to 50:1.

Generally, the reaction temperature is chosen in the range of from 40 to 180°C, preferably under reflux conditions.

Preferred, the reaction time is chosen in the range of from 1 to 80 hours, more preferably from 20 to 72 hours.

In a preferred embodiment a usual catalyst for coupling reactions or for polycondensation reactions is used, preferably Pd-based catalyst such as known tetrakis(triarylphosphonium)-palladium, preferably  $(Ph_3P)_4Pd$  and derivatives thereof. Usually, the catalyst is added in a molar ratio from inventive DPP polymer to the catalyst in the range of from 100:1 to 10:1, preferably from 50:1 to 30:1.

Also preferred, the catalyst is added as in solution or suspension. Preferably, an appropriate organic solvent such as the ones described above, preferably benzene, toluene, xylene, THF, dioxane, more preferably toluene, or mixtures thereof, is used. The amount of solvent usually is chosen in the range of from 1 to 10 l per mol of boronic acid derivative.

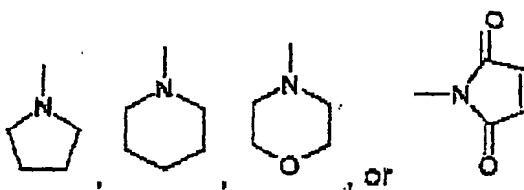
The obtained inventive polymer can be isolated by well-known methods. Preferably, after ~~pouring~~ down the reaction mixture to room temperature, it is poured into acetone and the obtained precipitation is filtered off, washed and dried.

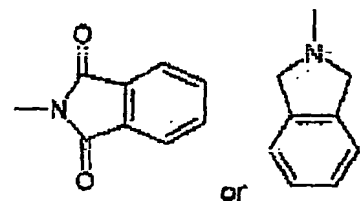
$C_1$ - $C_{18}$ alkyl is a branched or unbranched radical such as for example methyl, ethyl, propyl, isopropyl, n-butyl, sec-butyl, isobutyl, tert-butyl, 2-ethylbutyl, n-pentyl, isopentyl, 1-methylpentyl, 1,3-dimethylbutyl, n-hexyl, 1-methylhexyl, n-heptyl, isohexyl, 1,1,3,3-

dibenzo[b,d]thienyl, thianthrenyl, furyl, furfuryl, 2H-pyranyl, benzofuranyl, isobenzofuranyl, dibenzofuranyl, phenoxythienyl, pyrrolyl, imidazolyl, pyrazolyl, pyridyl, bipyridyl, triazinyl, pyrimidinyl, pyrazinyl, pyridazinyl, indoliziny, isoindolyl, indolyl, indazolyl, purinyl, quinoliziny, chinolyl, isochinolyl, phthalazinyl, naphthyridinyl, chinoxaliny, chinazoliny, cinnoliny, pteridinyl, carbazolyl, carbolinyl, benzotriazolyl, benzoxazolyl, phenanthridinyl, acridinyl, perimidinyl, phenanthrolinyl, phenazinyl, isothiazolyl, phenothiazinyl, isoxazolyl, furazanyl or phenoxazinyl, which can be unsubstituted or substituted.

Halogen is fluorine, chlorine, bromine and iodine.

Examples of a five or six membered ring formed by  $R^5$  and  $R^6$  and  $R^{103}$  and  $R^{104}$ , respectively are heterocycloalkanes or heterocycloalkenes having from 3 to 5 carbon atoms which can have one additional hetero atom selected from nitrogen, oxygen

and sulfur, for example  , which can be part of a

bicyclic system, for example  or

Possible substituents of the above-mentioned groups are  $C_1$ - $C_8$ alkyl, a hydroxyl group, a mercapto group,  $C_1$ - $C_8$ alkoxy,  $C_1$ - $C_8$ alkylthio, halogen, halo- $C_1$ - $C_8$ alkyl, a cyano group, an aldehyde group, a ketone group, a carboxyl group, an ester group, a carbamoyl group, an amino group, a nitro group or a silyl group.

As described above, the aforementioned radicals may be substituted by E and/or, if desired, interrupted by D. Interruptions are of course possible only in the case of radicals containing at least 2 carbon atoms connected to one another by single bonds;  $C_6$ - $C_{18}$ aryl is not interrupted; Interrupted arylalkyl or alkylaryl contains the unit D in the alkyl moiety.  $C_1$ - $C_{18}$ alkyl substituted by one or more E and/or interrupted by one or more units D is, for example,  $(CH_2CH_2O)_nR^x$ , where n is a number from the range 1-9 and  $R^x$  is H or  $C_1$ - $C_{10}$ alkyl or  $C_2$ - $C_{10}$ alkanoyl (e.g.  $CO-CH(C_2H_5)C_4H_9$ ),  $CH_2-CH(OR^y)-CH_2-O-R^y$ , where  $R^y$  is  $C_1$ - $C_{18}$ alkyl.

prevented by forming it as a multi-layered structure. The light-emitting material, a dopant, a hole-injecting material and an electron-injecting material may be used in combination as required. Further, a dopant can improve the light emission brightness and the light emission efficiency, and can attain the red or blue light emission. Further, each of the hole-injecting zone, the light-emitting layer and the electron-injecting zone may have the layer structure of at least two layers. In the hole-injecting zone in this case, a layer to which holes are injected from an electrode is called "hole-injecting layer", and a layer which receives holes from the hole-injecting layer and transport the holes to a light-emitting layer is called "hole-transporting layer". In the electron-injecting zone, a layer to which electrons are injected from an electrode is called "electron-injecting layer", and a layer which receives electrons from the electron-injecting layer and transports the electrons to a light-emitting layer is called "electron-transporting layer". These layers are selected and used depending upon factors such as the energy level and heat resistance of materials and adhesion to an organic layer or metal electrode.

The light-emitting material or the dopant which may be used in the light-emitting layer together with the organic compounds of the present invention includes for example anthracene, naphthalene, phenanthrene, pyrene, tetracene, coronene, chrysene, fluorescein, perylene, phthaloperylene, naphthaloperylene, perinone, phthaoperinone, naphthaloperinone, diphenylbutadiene, tetraphenylbutadiene, coumarine, oxadiazole, aldazine, bisbenzoxazoline, bisstyryl, pyrazine, cyclopentadiene, quinoline metal complex, aminoquinoline metal complex, benzoquinoline metal complex, imine, diphenylethylene, vinyl anthracene, diaminocarbazole, pyran, thiopyran, polymethine, merocyanine, an imidazole-chelated oxynoid compound, quinacridone, rubrene, and fluorescent dyestuffs for a dyestuff laser or for brightening.

The organic compounds of the present invention and the above compound or compounds that can be used in a light-emitting layer may be used in any mixing ratio for forming a light-emitting layer. That is, the organic compounds of the present invention may provide a main component for forming a light-emitting layer, or they may be a doping material in another main material, depending upon a combination of the above compounds with the organic compounds of the present invention.

The hole-injecting material is selected from compounds which are capable of transporting holes, are capable of receiving holes from the anode, have an excellent effect of injecting holes to a light-emitting layer or a light-emitting material, prevent the movement of excitons generated in a light-emitting layer to an electron-injecting zone or an electron-injecting material and have the excellent capability of forming a thin film. Suitable hole-injecting materials include for example a phthalocyanine derivative, a naphthalocyanine derivative, a

hydroxybenzo[h]quinolate), chlorogallium bis(2-methyl-8-quinolate), gallium bis(2-methyl-8-quinolate)(o-cresolate), aluminum bis(2-methyl-8-quinolate)(1-naphtholate), gallium bis(2-methyl-8-quinolate)(2-naphtholate), gallium bis(2-methyl-8-quinolate)phenolate, zinc bis(o-(2-benzooxazolyl)phenolate), zinc bis(o-(2-benzothiazolyl)phenolate) and zinc bis(o-(2-benzotriazolyl)phenolate). The nitrogen-containing five-membered derivative is preferably an oxazole, thiazole, thiadiazole, or triazole derivative. Although not specially limited, specific examples of the above nitrogen-containing five-membered derivative include 2,5-bis(1-phenyl)-1,3,4-oxazole, 1,4-bis(2-(4-methyl-5-phenyloxazolyl)benzene, 2,5-bis(1-phenyl)-1,3,4-thiazole, 2,5-bis(1-phenyl)-1,3,4-oxadiazole, 2-(4'-tert-butylphenyl)-5-(4"-biphenyl)1,3,4-oxadiazole, 2,5-bis(1-naphthyl)-1,3,4-oxadiazole, 1,4-bis[2-(5-phenyloxadiazolyl)]benzene, 1,4-bis[2-(5-phenyloxadiazolyl)-4-tert-butylbenzene], 2-(4'-tert-butylphenyl)-5-(4"-biphenyl)-1,3,4-thiadiazole, 2,5-bis(1-naphthyl)-1,3,4-thiadiazole, 1,4-bis[2-(5-phenylthiazolyl)]benzene, 2-(4'-tert-butylphenyl)-5-(4"-biphenyl)-1,3,4-triazole, 2,5-bis(1-naphthyl)-1,3,4-triazole and 1,4-bis[2-(5-phenyltriazolyl)]benzene.

In the organic EL device of the present invention, the light-emitting layer may contain, in addition to the light-emitting organic material of the present invention, at least one of other light-emitting material, other dopant, other hole-injecting material and other electron-injecting material. For improving the organic EL device of the present invention in the stability against temperature, humidity and ambient atmosphere, a protective layer may be formed on the surface of the device, or the device as a whole may be sealed with a silicone oil, or the like. The electrically conductive material used for the anode of the organic EL device is suitably selected from those materials having a work function of greater than 4 eV. The electrically conductive material includes carbon, aluminum, vanadium, iron, cobalt, nickel, tungsten, silver, gold, platinum, palladium, alloys of these, metal oxides such as tin oxide and indium oxide used for ITO substrates or NESA substrates, and organic electroconducting polymers such as polythiophene and polypyrrole.

The electrically conductive material used for the cathode is suitably selected from those having a work function of smaller than 4 eV. The electrically conductive material includes magnesium, calcium, tin, lead, titanium, yttrium, lithium, ruthenium, manganese, aluminum and alloys of these, while the electrically conductive material shall not be limited to these. Examples of the alloys include magnesium/silver, magnesium/indium and lithium/aluminum, while the alloys shall not be limited to these. Each of the anode and the cathode may have a layer structure formed of two layers or more as required.

For the effective light emission of the organic EL device, at least one of the electrodes is desirably sufficiently transparent in the light emission wavelength region of the device. Further, the substrate is desirably transparent as well. The transparent electrode is

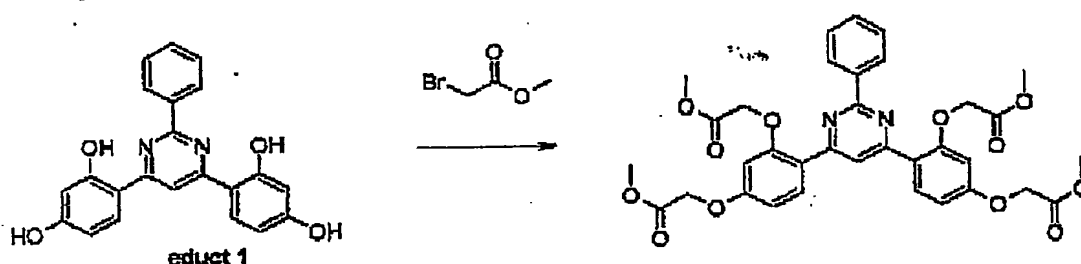
light source for a copying machine or a printer, a light source for a liquid crystal display or counter, a display signboard and a signal light.

The material of the present invention can be used in the fields of an organic EL device, an electrophotographic photoreceptor, a photoelectric converter, a solar cell, an image sensor, and the like.

The following Examples illustrate the invention. In the Examples and throughout this application, the term light emitting material means the present pyrimidine compounds.

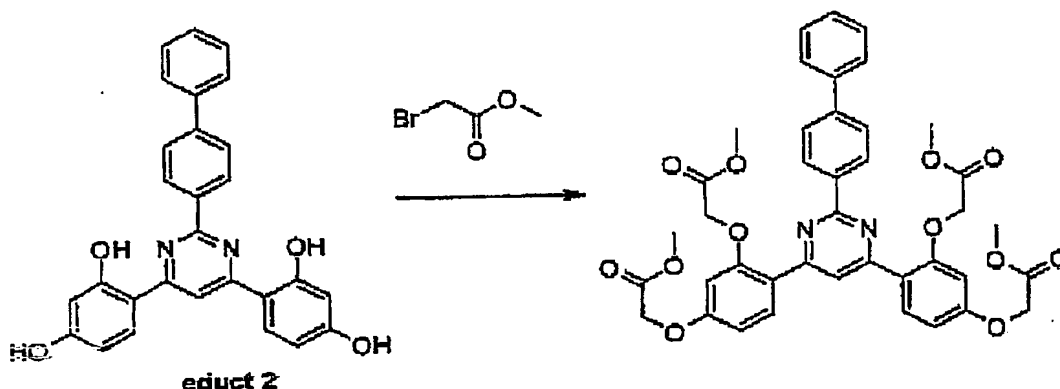
### Examples

#### Example 1 (A-1)



To 1.00 g (2.69 mmol) of educt 1 (prepared according to US-A-3,442,898 from resorcinol and 4,6-dichloro-2-phenyl-pyrimidine; J. Org. Chem. 1988, 53, 4137) in 20 ml water free DMF 5.29 g (21.5 mmol) methyl-bromoacetate and 2.97 g (21.5 mmol) potassium carbonate are added. The reaction mixture is stirred at 100 °C under nitrogen for 2 h. The reaction mixture is diluted with water. The organic phase is extracted with dichloromethane und dried with magnesium sulfate. The solvent is removed. After chromatography of the crude product on silica gel with toluene / ethyl acetate 8/2 the desired product is obtained. Melting point: 178.0 – 179.0 °C.

#### Example 2 (A-2)



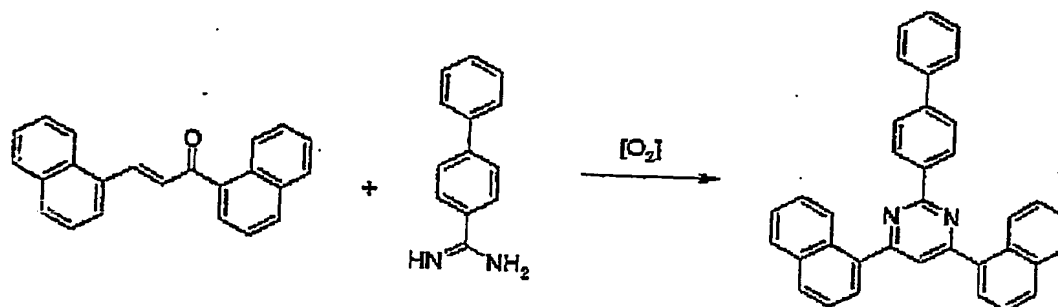
27

Cpd.	X <sup>2</sup>	Y <sup>2</sup>	W <sup>2</sup>	X <sup>3</sup>	Y <sup>3</sup>	W <sup>3</sup>	V
A-1	H	OCH <sub>2</sub> COOMe	OCH <sub>2</sub> COOMe	H	OCH <sub>2</sub> COOMe	OCH <sub>2</sub> COOMe	H
A-2	Ph	OCH <sub>2</sub> COOMe	OCH <sub>2</sub> COOMe	H	OCH <sub>2</sub> COOMe	OCH <sub>2</sub> COOMe	H
A-3	H	OMe	OMe	H	H	H	H
A-4	H	Ph	Ph	H	H	H	H
A-5	H	OMe	OMe	H	OMe	OMe	H
A-6	H	OBu	OBu	H	H	H	H
A-7	H	OBu	OBu	H	OBu	OBu	H
A-8	OMe	OMe	OMe	OMe	OMe	OMe	H
A-9	OMe	Br	Br	OMe	H	H	H
A-10	Ph	Br	Br	H	H	H	H
A-11	OMe	Ph	Ph	OMe	H	H	H
A-12	Ph	Ph	Ph	H	H	H	H
A-13	SiMe	SiMe	SiMe	H	H	H	H
A-14	H	SiMe	SiMe	H	H	H	H
A-15	H	OCH <sub>2</sub> CH <sub>2</sub> OAc	OCH <sub>2</sub> CH <sub>2</sub> OAc	H	H	H	H
A-16	H	OCH <sub>2</sub> CH <sub>2</sub> OAc	OCH <sub>2</sub> CH <sub>2</sub> OAc	H	OCH <sub>2</sub> CH <sub>2</sub> OAc	OCH <sub>2</sub> CH <sub>2</sub> OAc	H
A-17	H	OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> Et	OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> Et	H	H	H	H
A-18	H	OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> Et	OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> Et	H	OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> Et	OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> Et	H
A-19	H	N(CH <sub>3</sub> ) <sub>2</sub>	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	H	H
A-20	H	-N<	-N<	H	H	H	H
A-21	Ph	N(CH <sub>3</sub> ) <sub>2</sub>	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	H	H
A-22	Ph	-N<	-N<	H	H	H	H
A-23	H	CH <sub>3</sub>	CH <sub>3</sub>	H	H	H	H
A-24	Ph	CH <sub>3</sub>	CH <sub>3</sub>	H	H	H	H
A-25	Ph	Ph	Ph	H	H	H	CH <sub>3</sub>
A-26	OMe	OMe	OMe	H	H	H	CH <sub>3</sub>
A-27	H	Ph	Ph	H	H	H	CH <sub>3</sub>

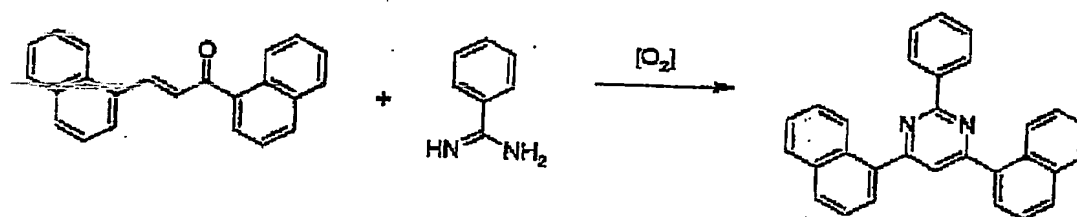
\*melting point 244-245°C.



29

**Example 4 (B-1)**

To 5.00 g (16.1 mmol) of 1,3-bis- $\alpha$ -naphthyl-2-propen-1-one (1) in 25 ml water free ethanol 1.89 g (8.11 mmol) biphenylbenzamidinium hydrochloride are added. A solution of 1.07 g (19.08 mmol) potassium hydroxide in 25 ml water free ethanol is added during 15 min. Dry air was bubbled through the reaction mixture. The reaction mixture is refluxed for 24 h. The reaction mixture is poured into water. The solid is filtered off and is washed with water. The product is crystallized 2 times from acetic acid (96-98 %). Melting point: 226-230 °C.

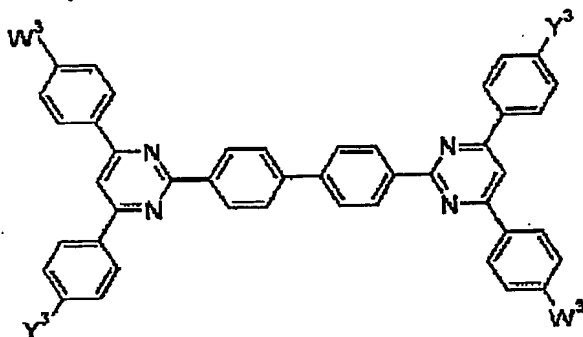
**Example 5 (B-2)**

To 5.00 g (16.1 mmol) of 1,3-bis- $\alpha$ -naphthyl-2-propen-1-one (1) in 25 ml water free ethanol 1.27 g (8.11 mmol) benzamidinium hydrochloride are added. A solution of 1.07 g (19.08 mmol) potassium hydroxide in 25 ml water free ethanol is added during 15 min. Dry air is bubbled through the reaction mixture. The reaction mixture is refluxed for 24 h. The reaction mixture is poured into water. The solid is filtered off and is washed with water. The product is crystallized from acetic acid (96-98 %). Melting point: 179-180 °C.

water and the water phase is extracted with dichloromethane. The organic phase is dried with magnesium sulfate, the solvent is removed by distillation and the remaining residue is purified by column chromatography (toluene / hexane 2/1).

$^1\text{H-NMR}$  (300 MHz,  $\text{CDCl}_3$ ):  $\delta$ = 8.75-8.72 (m, 4H); 8.45-8.37 (m, 12H); 8.04-7.82 (m, 6H); 7.67-7.50 (m, 12h).

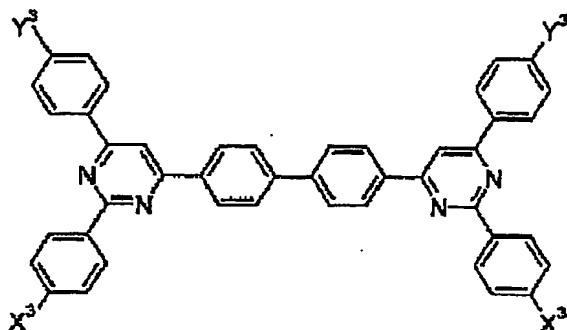
Compounds C-2 to C-24 can be obtained in a manner analogous to Example 6.



Cpd.	$W^3$	$Y^3$
C-2	H	H
C-3	H	H
C-4	H	H
C-5	H	H
C-6	H	H
C-7	$\text{OCH}_3$	$\text{OCH}_3$
C-8	$\text{OCH}_3$	$\text{OCH}_3$
C-9	$\text{OCH}_3$	$\text{OCH}_3$
C-10	$\text{OCH}_3$	$\text{OCH}_3$
C-11	$\text{OCH}_3$	$\text{OCH}_3$
C-12	$\text{SCH}_3$	$\text{SCH}_3$
C-13	$\text{SCH}_3$	$\text{SCH}_3$
C-14	$\text{SCH}_3$	$\text{SCH}_3$
C-15	$\text{SCH}_3$	$\text{SCH}_3$
C-16	$\text{SCH}_3$	$\text{SCH}_3$
C-17	$\text{SCH}_3$	$\text{SCH}_3$
C-18	$\text{N}(\text{CH}_3)_2$	$\text{N}(\text{CH}_3)_2$
C-19	$\text{N}(\text{CH}_3)_2$	$\text{N}(\text{CH}_3)_2$
C-20	$\text{N}(\text{CH}_3)_2$	$\text{N}(\text{CH}_3)_2$
C-21	$\text{N}(\text{CH}_3)_2$	$\text{N}(\text{CH}_3)_2$
C-22	$\text{N}(\text{CH}_3)_2$	$\text{N}(\text{CH}_3)_2$
C-23	$\text{N}(\text{CH}_3)_2$	$\text{N}(\text{CH}_3)_2$
C-24	$\text{N}(\text{CH}_3)_2$	$\text{N}(\text{CH}_3)_2$

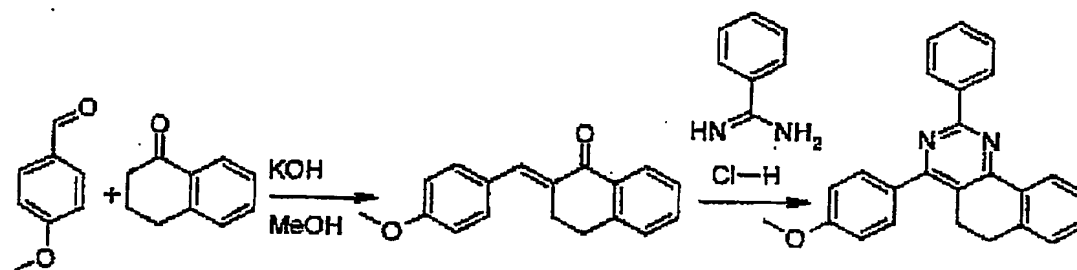
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Compounds E-1 to E-35 can be obtained in a manner analogous to Example 6.



Cpd.	Y <sup>3</sup>	X <sup>3</sup>
E-1	H	H
E-2	H	H
E-3	H	H
E-4	H	H
E-5	H	H
E-6	OCH <sub>3</sub>	OCH <sub>3</sub>
E-7	OCH <sub>3</sub>	OCH <sub>3</sub>
E-8	OCH <sub>3</sub>	OCH <sub>3</sub>
E-9	OCH <sub>3</sub>	OCH <sub>3</sub>
E-10	OCH <sub>3</sub>	OCH <sub>3</sub>
E-11	OCH <sub>3</sub>	H
E-12	OCH <sub>3</sub>	H
E-13	OCH <sub>3</sub>	H
E-14	OCH <sub>3</sub>	H
E-15	OCH <sub>3</sub>	H
E-16	SCH <sub>3</sub>	SCH <sub>3</sub>
E-17	SCH <sub>3</sub>	SCH <sub>3</sub>
E-18	SCH <sub>3</sub>	SCH <sub>3</sub>
E-19	SCH <sub>3</sub>	SCH <sub>3</sub>
E-20	SCH <sub>3</sub>	SCH <sub>3</sub>
E-21	SCH <sub>3</sub>	H
E-22	SCH <sub>3</sub>	H
E-23	SCH <sub>3</sub>	H
E-24	SCH <sub>3</sub>	H
E-25	SCH <sub>3</sub>	H
E-26	N(CH <sub>3</sub> ) <sub>2</sub>	N(CH <sub>3</sub> ) <sub>2</sub>
E-27	N(CH <sub>3</sub> ) <sub>2</sub>	N(CH <sub>3</sub> ) <sub>2</sub>
E-28	N(CH <sub>3</sub> ) <sub>2</sub>	N(CH <sub>3</sub> ) <sub>2</sub>
E-29	N(CH <sub>3</sub> ) <sub>2</sub>	N(CH <sub>3</sub> ) <sub>2</sub>
E-30	N(CH <sub>3</sub> ) <sub>2</sub>	N(CH <sub>3</sub> ) <sub>2</sub>
E-31	N(CH <sub>3</sub> ) <sub>2</sub>	H
E-32	N(CH <sub>3</sub> ) <sub>2</sub>	H
E-33	N(CH <sub>3</sub> ) <sub>2</sub>	H
E-34	N(CH <sub>3</sub> ) <sub>2</sub>	H
E-35	N(CH <sub>3</sub> ) <sub>2</sub>	H

35

**Example 7 (G-1)**

(G-1)

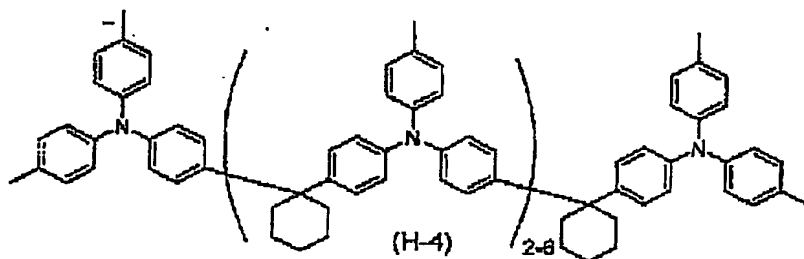
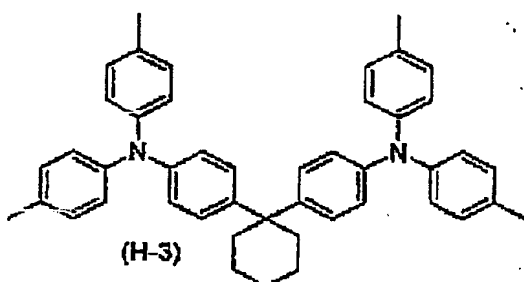
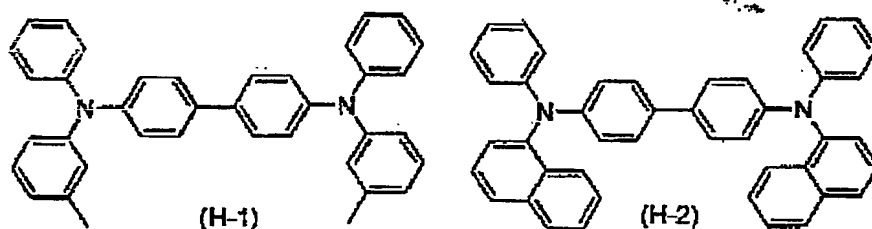
To 14.6 g (0.100 mol) of tetralone and 15.0 g (1.10 mol) p-methoxy-benzaldehyd in 100 ml absolute methanol 660 mg potassium hydroxide are added. The reaction mixture is refluxed for 18 h under argon and then cooled to 25 °C. The formed product is filtered off and washed with methanol. To 6.61 g (25.0 mmol) of said product in 50 ml water free ethanol 1.96 g (12.5 mmol) benzamidine hydrochloride are added. A solution of 1.65 g (25.0 mmol) potassium hydroxide in 50 ml water free ethanol is added during 15 min. Dry air is bubbled through the reaction mixture. The reaction mixture is refluxed for 24 h and then poured into water. The water phase is extracted with dichloromethane. The organic phase is dried with magnesium sulfate, the solvent is removed by distillation and the remaining residue is purified by column chromatography (toluene / hexane 1/1). The product G-1 having a melting point of 169 °C is obtained.

**Application Example 1**

Present compounds A1, A2, A3, B1, B2, C1 and G1 as light emitting materials, respectively, 2,5-bis(1-naphthyl)-1,3,4-oxadiazole and a polycarbonate resin in a weight ratio of 5:3:2 are dissolved in tetrahydrofuran, and the solution is spin-coated on a cleaned glass substrate with an ITO electrode to form a light-emitting layer having a thickness of 100 nm. An electrode having a thickness of 150 nm is formed thereon from a magnesium/indium alloy having a magnesium/indium mixing ratio of 10/1, to obtain an organic EL device. The device exhibits light emission with excellent brightness and efficiency at a direct current voltage of 5 V.

**Application Example 5**

One of hole-injecting materials (H-1) to (H-6) is vacuum-deposited on a cleaned glass substrate with an ITO electrode, to form a hole-injecting layer having a thickness of 30 nm. Then, one of light-emitting materials A1, A2, A3, B1, B2, C1 and G1, respectively is vacuum-deposited to form a light-emitting layer having a thickness of 30 nm. Further, one of electron-injecting materials (E-1) to (E-6) is vacuum-deposited to form an electron-injecting layer having a thickness of 30 nm. An electrode having a thickness of 150 nm is formed thereon from a magnesium/silver alloy having a magnesium/silver mixing ratio of 10/1, to obtain an organic EL device. Each layer is formed under a vacuum of  $10^{-6}$  Torr at a substrate temperature of room temperature. All the organic EL devices obtained in these Examples shows high brightness and efficiency.



**Application Example 7**

On a cleaned glass substrate with an ITO electrode, 4,4',4"-tris(N-(1-naphthyl)-N-phenylamino)triphenylamine is vacuum-deposited to form a first hole-injecting layer having a thickness of 25 nm. Further, a hole-injecting material (H-2) is vacuum-deposited to form a second hole-injecting layer having a thickness of 5 nm. Then, compounds A1, A2, A3, B1, B2, C1 and G1, respectively, as light-emitting materials are vacuum-deposited to form a light-emitting layer having a thickness of 20 nm. Further, an electron-injecting material (E-5) is vacuum-deposited to form an electron-injecting layer having a thickness of 30 nm. Then, an electrode having a thickness of 150 nm is formed thereon from a magnesium/silver alloy having an magnesium/silver mixing ratio of 10/1, to obtain an organic EL device. The device shows an emission having a outstanding brightness and efficiency at a direct current voltage of 5 V.

**Application Example 8**

A hole-injecting material (H-5) is vacuum-deposited on a cleaned glass substrate with an ITO electrode to form a hole-injecting layer having a thickness of 20 nm. Then, compounds A1, A2, A3, B1, B2, C1 and G1, respectively, as light-emitting materials are vacuum-deposited to form a light-emitting layer having a thickness of 20 nm. Further, an electron-injecting material (E-2) is vacuum-deposited to form a first electron-injecting layer having a thickness of 20 nm. Then, an electron-injecting material (E-5) is vacuum-deposited to form a second electron-injecting layer having a thickness of 10 nm, and an electrode having a thickness of 150 nm is formed thereon from a magnesium/silver alloy having an magnesium/silver mixing ratio of 10/1, to obtain an organic EL device. The device shows light emission having an excellent brightness and efficiency at a direct current voltage of 5 V.

**Application Example 9**

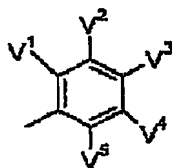
An organic EL device is prepared in the same manner as in Example 5 except that the light-emitting layer is replaced with a 30 nm thick light-emitting layer formed by vacuum-depositing compounds A1, A2, A3, B1, B2, C1 and G1, respectively, and one of the dopant compounds (D-1) to (D-7) in a weight ratio of 100:1. All the organic EL devices obtained in these Examples shows high brightness characteristics and gives intended light emission colors.

### Application Example 12

An organic EL device is prepared in the same manner as in Example 11 except that the light-emitting layer is replaced with a 30 nm thick light-emitting layer formed by vacuum-depositing aluminum tris(8-hydroxyquinolate) and one of the light-emitting materials A1, A2, A3, B1, B2, C1 and G1 in a weight ratio of 100:3. All the organic EL devices obtained in these Examples shows high brightness characteristics at a direct current of 5 V.

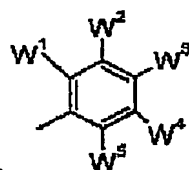
The organic EL devices obtained in the Application Examples of the present invention show an excellent light emission brightness and achieved a high light emission efficiency. When the organic EL devices obtained in the above Examples are allowed to continuously emit light at 3 (mA/cm<sup>2</sup>), all the organic EL devices remain stable. Since the light-emitting materials of the present invention have a very high fluorescence quantum efficiency, the organic EL devices using the light-emitting materials achieved light emission with a high brightness in a low electric current applied region, and when the light-emitting layer additionally uses a doping material, the organic EL devices are improved in maximum light emission brightness and maximum light emission efficiency. Further, by adding a doping material having a different fluorescent color to the light-emitting material of the present invention, there are obtained light-emitting devices having a different light emission color. The organic EL devices of the present invention accomplish improvements in light emission efficiency and light emission brightness and a longer device life, and does not impose any limitations on a light-emitting material, a dopant, a hole-injecting material, an electron-injecting material, a sensitizer, a resin and an electrode material used in combination and the method of producing the device. The organic EL device using the material of the present invention as a light-emitting material achieves light emission having a high brightness with a high light emission efficiency and a longer life as compared with conventional devices. According to the light-emitting material of the present invention and the organic EL device of the present invention, there can be achieved an organic EL device having a high brightness, a high light emission efficiency and a long life.

V is  $C_6-C_{24}$ aryl or  $C_2-C_{24}$ heteroaryl, which can be substituted or unsubstituted, in



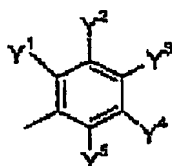
particular , H,  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl,  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $-SR^5$ ;  $-NR^5R^6$ ;

W is  $C_6-C_{24}$ aryl or  $C_2-C_{24}$ heteroaryl, which can be substituted or unsubstituted, in



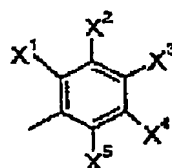
particular , H,  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl,  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $-SR^5$ ;  $-NR^5R^6$ ;

Y is  $C_6-C_{24}$ aryl or  $C_2-C_{24}$ heteroaryl, which can be substituted or unsubstituted, in



particular , H,  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl,  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $-SR^5$ ;  $-NR^5R^6$ ;

X is  $C_6-C_{24}$ aryl or  $C_2-C_{24}$ heteroaryl, which can be substituted or unsubstituted, in



particular , H,  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl,  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkoxy which is substituted by E and/or



$C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;

$C_1-C_{18}$ alkoxy,  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $-SR^5$ ;  $-NR^5R^6$ ;  $C_2-C_{18}$ heteroaryl;  $C_2-C_{18}$ heteroaryl which is substituted by L;  $-SOR^4$ ;  $-SO_2R^4$ ;

$-COR^6$ ;  $-COOR^7$ ;  $-CONR^5R^6$ ;  $C_4-C_{18}$ cycloalkyl;  $C_4-C_{18}$ cycloalkyl which is substituted by E and/or interrupted by D;  $C_4-C_{18}$ cycloalkenyl;  $C_4-C_{18}$ cycloalkenyl which is substituted by E and/or interrupted by D; or

two substituents  $A^1$ ,  $B^1$ ,  $B^2$  or  $B^1$  and  $B^2$  form a five to seven membered ring, which can be substituted,

m is an integer of 1 to 4; and  $W^1$ ,  $W^2$ ,  $Y^1$ ,  $Y^2$ ,  $X^1$ ,  $X^2$ , V, W, X and Y are as defined above;

D is  $-CO-$ ;  $-COO-$ ;  $-OCOO-$ ;  $-S-$ ;  $-SO-$ ;  $-SO_2-$ ;  $-O-$ ;  $-NR^5-$ ;  $-SiR^5R^6-$ ;  $-POR^5-$ ;  $-CR^5=CR^6-$ ; or  $-C\equiv C-$ ;

E is  $-OR^5$ ;  $-SR^5$ ;  $-NR^5R^6$ ;  $-COR^6$ ;  $-COOR^7$ ;  $-CONR^5R^6$ ;  $-CN$ ;  $-OCOOR^7$ ; or halogen;

G is E; K; heteroaryl; heteroaryl which is substituted by  $C_6-C_{18}$ aryl;  $C_6-C_{18}$ aryl which is substituted by E and/or K;

K is  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_7-C_{18}$ alkylaryl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl;  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy,  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $C_4-C_{18}$ cycloalkyl;  $C_4-C_{18}$ cycloalkyl which is substituted by E and/or interrupted by D;  $C_4-C_{18}$ cycloalkenyl; or  $C_4-C_{18}$ cycloalkenyl which is substituted by E and/or interrupted by D;

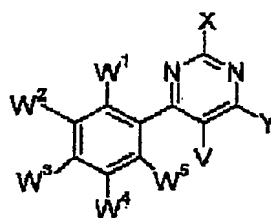
L is E; K;  $C_6-C_{18}$ aryl; or  $C_6-C_{18}$ aryl which is substituted by G, E and/or K;

$R^4$  is  $C_6-C_{18}$ aryl;  $C_6-C_{18}$ aryl which is substituted by  $C_1-C_{18}$ alkyl,  $C_1-C_{18}$ alkoxy,  $C_1-C_{18}$ alkyl; or  $C_1-C_{18}$ alkyl which is interrupted by  $-O-$ ;

$R^5$  and  $R^6$  are independently of each other H;  $C_6-C_{18}$ aryl;  $C_6-C_{18}$ aryl which is substituted by  $C_1-C_{18}$ alkyl,  $C_1-C_{18}$ alkoxy,  $C_1-C_{18}$ alkyl; or  $C_1-C_{18}$ alkyl which is interrupted by  $-O-$ ;

or

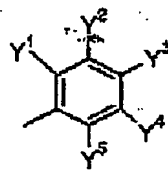
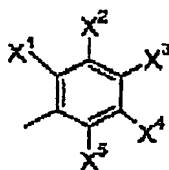
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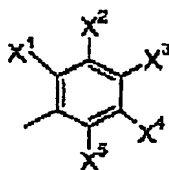
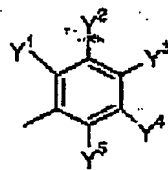


(III),

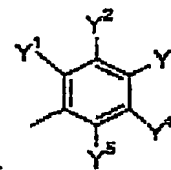
wherein V, X, Y and W<sup>1</sup> to W<sup>5</sup> are as defined in claim 9.

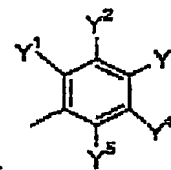
12. An electroluminescent device according to claim 11, comprising a pyrimidine compound of formula III, wherein



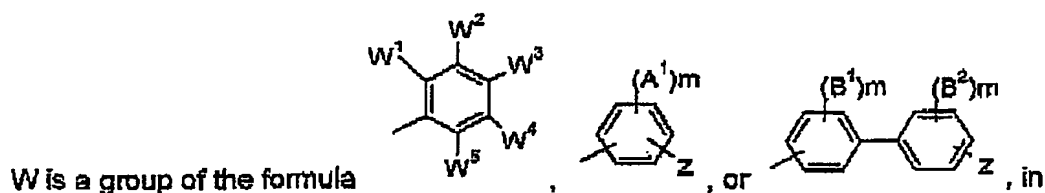
Y is R<sup>1</sup>, if X is , or X is R<sup>1</sup>, if Y is , R<sup>1</sup> is H, C<sub>1</sub>-C<sub>18</sub>alkyl; C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkenyl; C<sub>2</sub>-C<sub>18</sub>alkenyl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkynyl; C<sub>2</sub>-C<sub>18</sub>alkynyl which is substituted by E and/or interrupted by D; C<sub>1</sub>-C<sub>18</sub>alkoxy; C<sub>1</sub>-C<sub>18</sub>alkoxy which is substituted by E and/or interrupted by D; -SR<sup>5</sup>; or -NR<sup>5</sup>R<sup>6</sup>; wherein X<sup>1</sup> to X<sup>5</sup>, Y<sup>1</sup> to Y<sup>5</sup>, E, D, R<sup>5</sup> and R<sup>6</sup> are as defined in claim 9.

13. An electroluminescent device according to claim 11, wherein V in formula III is H.

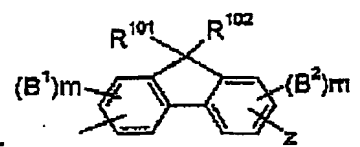


14. An electroluminescent device according to claim 11, wherein Y is  wherein W<sup>1</sup> and W<sup>5</sup> and Y<sup>1</sup> and Y<sup>5</sup> are independently of each other H; C<sub>1</sub>-C<sub>18</sub>alkyl; or C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or interrupted by D.
15. An electroluminescent device according to claim 9, comprising a pyrimidine compound of formula

49

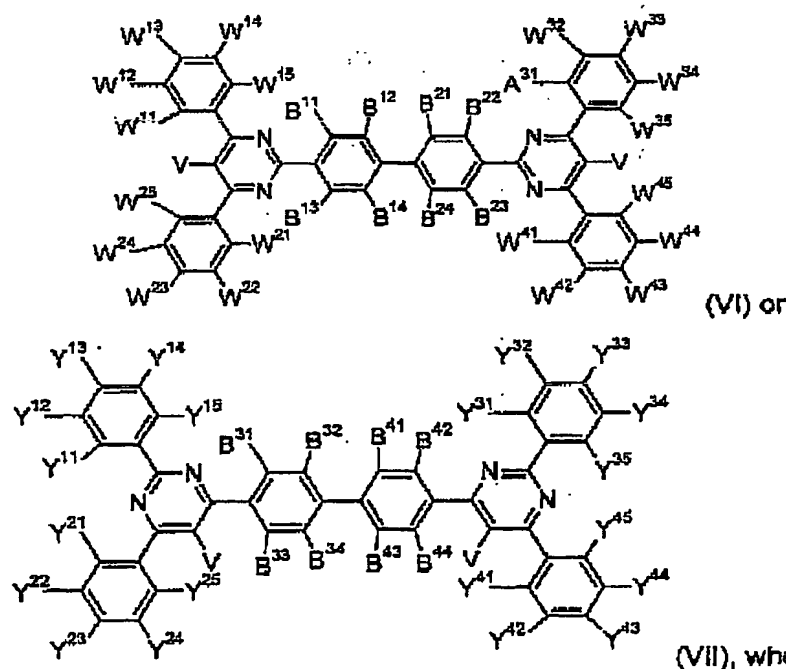


particular



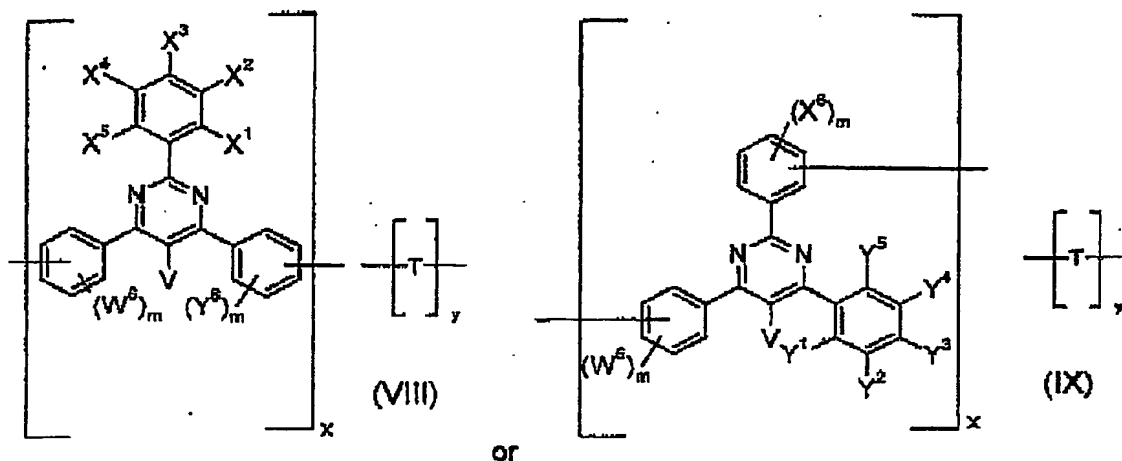
, H, C<sub>1</sub>-C<sub>18</sub>alkyl; C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkenyl, C<sub>2</sub>-C<sub>18</sub>alkenyl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkynyl; C<sub>2</sub>-C<sub>18</sub>alkynyl which is substituted by E and/or interrupted by D; C<sub>1</sub>-C<sub>18</sub>alkoxy; C<sub>1</sub>-C<sub>18</sub>alkoxy which is substituted by E and/or interrupted by D; -SR<sup>5</sup>; or -NR<sup>5</sup>R<sup>6</sup>; wherein W<sup>1</sup> to W<sup>5</sup>, D, V<sup>1</sup> to V<sup>5</sup>, E, A<sup>1</sup>, B<sup>1</sup>, B<sup>2</sup>, R<sup>5</sup>, R<sup>6</sup>, m and Z are as defined in claim 9 and R<sup>101</sup> and R<sup>102</sup> are independently of each other H, C<sub>1</sub>-C<sub>8</sub>alkyl, C<sub>6</sub>-C<sub>24</sub>aryl, or C<sub>5</sub>-C<sub>7</sub>cycloalkyl, in particular H or C<sub>1-4</sub>alkyl.

20. An electroluminescent device according to claim 9, comprising a pyrimidine compound of formula

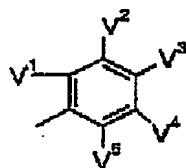


W<sup>11</sup> to W<sup>15</sup>, W<sup>21</sup> to W<sup>25</sup>, W<sup>31</sup> to W<sup>35</sup>, W<sup>41</sup> to W<sup>45</sup>, Y<sup>11</sup> to Y<sup>15</sup>, Y<sup>21</sup> to Y<sup>25</sup>, Y<sup>31</sup> to Y<sup>35</sup> and Y<sup>41</sup> to Y<sup>45</sup> are independently of each other H; C<sub>6</sub>-C<sub>18</sub>aryl; C<sub>6</sub>-C<sub>18</sub>aryl which is substituted by G; C<sub>1</sub>-C<sub>18</sub>alkyl; C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or interrupted by D; C<sub>7</sub>-C<sub>18</sub>alkylaryl; C<sub>7</sub>-C<sub>18</sub>alkylaryl which is substituted by E and/or interrupted by D; C<sub>2</sub>-

51

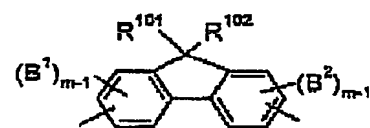
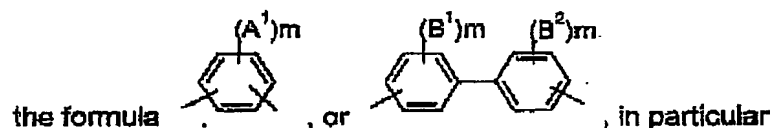


wherein  $x$  is chosen in the range of from 0.005 to 1, preferably from 0.01 to 1, and  $y$  from 0.995 to 0, preferably 0.99 to 0, and wherein  $x + y = 1$ ,  $V$  is a group of the formula



, H,  $C_1-C_{18}$ alkyl;  $C_1-C_{18}$ alkyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkenyl,  $C_2-C_{18}$ alkenyl which is substituted by E and/or interrupted by D;  $C_2-C_{18}$ alkynyl;  $C_2-C_{18}$ alkynyl which is substituted by E and/or interrupted by D;  $C_1-C_{18}$ alkoxy;  $C_1-C_{18}$ alkoxy which is substituted by E and/or interrupted by D;  $-SR^6$ ; or  $-NR^6R^6$ ; and

T is  $C_6-C_{24}$ -aryl or  $C_5-C_{24}$ -heteroaryl, which can be substituted, in particular a group of



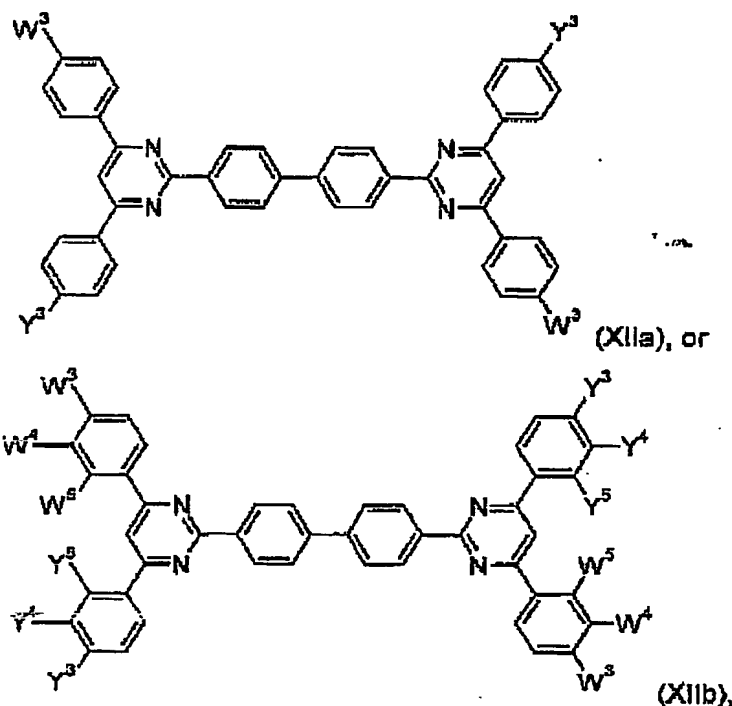
wherein  $X^1$  to  $X^5$ ,  $Y^1$  to  $Y^5$ , D,  $V^1$  to  $V^5$ , E,  $A^1$ ,  $B^1$ ,  $B^2$ ,  $R^6$ ,  $R^6$ ,  $m$  are as defined above.  $W^6$ ,  $X^6$  and  $Y^6$  independently of each other have the same meanings as  $X^1$ , and  $R^{101}$  and  $R^{102}$  are independently of each other H,  $C_1-C_8$ alkyl,  $C_6-C_{24}$ aryl, or  $C_5-C_7$ cycloalkyl.

23. An electroluminescent device according to claim 9, wherein the pyrimidine compound has the following formula

53

$Y^3$  is H,  $C_1-C_8$ alkyl, or  $C_1-C_8$ alkoxy, wherein  $n_1$  is an integer of 1 to 4 and X is  $-O-(CH_2)_{m_1}CH_3$ ,  $-OC(O)-(CH_2)_{m_1}CH_3$ ,  $-C(O)-O-C_1-C_8$ alkyl, wherein  $m_1$  is an integer of 0 to 5.

25. An electroluminescent device according to claim 9, wherein the organic compound has the following formula



wherein  $W^3$  and  $W^4$  are independently of each other H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy,

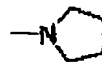
$Y^3$  and  $Y^4$  are independently of each other H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy, wherein  $R^{103}$  and  $R^{104}$  are independently of each other H, or  $C_1-C_8$ alkyl.

$W^5$  is H,  $C_1-C_8$ alkyl, or  $O(CH_2)_{n_1}-X$ .

$Y^5$  is H,  $C_1-C_8$ alkyl, or  $O(CH_2)_{n_1}-X$ .

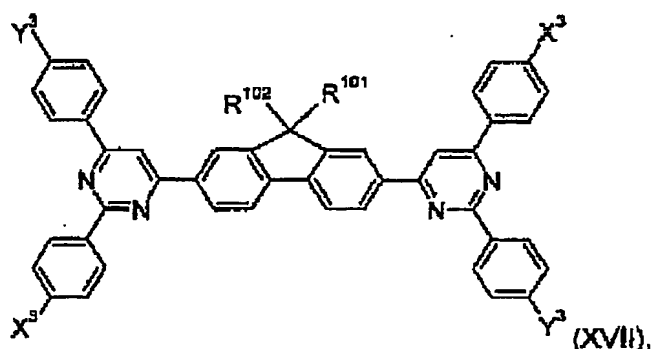
wherein  $n_1$  is an integer of 1 to 5 and X is  $-O-(CH_2)_{m_1}CH_3$ ,  $-OC(O)-(CH_2)_{m_1}CH_3$ ,  $-C(O)-O-C_1-C_8$ alkyl,  $-NR^{103}R^{104}$ , wherein  $m_1$  is an integer of 0 to 5 and  $R^{103}$  and  $R^{104}$  are independently of each other H, or  $C_1-C_8$ alkyl, or  $R^{103}$  and  $R^{104}$  together form a five

or six membered heterocyclic ring, in particular



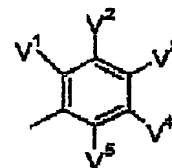
26. An electroluminescent device according to claim 9, wherein the organic compound has the following formula

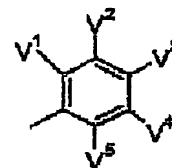
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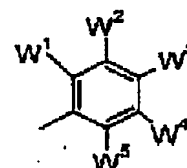


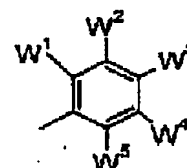
$Y^3$  is H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy.

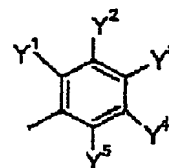
$X^3$  is H,  $-NR^{103}R^{104}$ ,  $C_1-C_8$ thioalkyl, or  $C_1-C_8$ alkoxy, wherein  $R^{103}$  and  $R^{104}$  are independently of each other H, or  $C_1-C_8$ alkyl,  $R^{101}$  and  $R^{102}$  are independently of each other H,  $C_1-C_8$ alkyl, phenyl, or  $C_5-C_7$ cycloalkyl, in particular cyclohexyl.

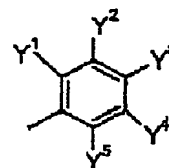


29. An electroluminescent device according to claim 9, wherein V is , wherein  $V^1$  to  $V^5$  are as defined in claim 9, with the proviso that at least one of the substituents  $V^1$  to  $V^5$  is different from H.

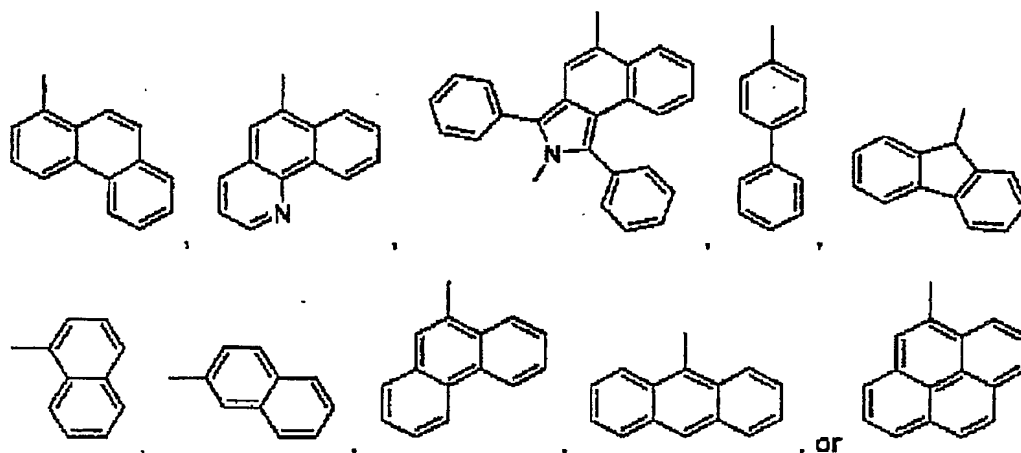


30. An electroluminescent device according to claim 9, wherein W is , wherein  $W^1$  to  $W^5$  are as defined in claim 9, with the proviso that at least one of the substituents  $W^1$  to  $W^5$  is different from H.

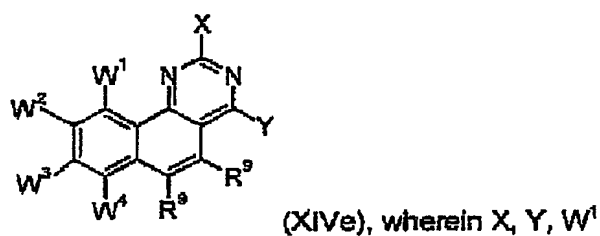
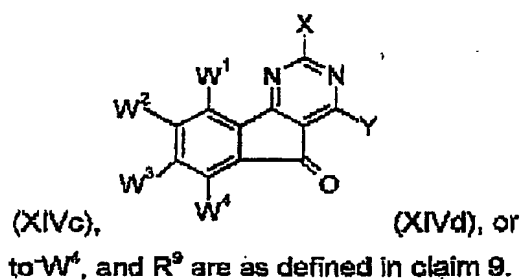
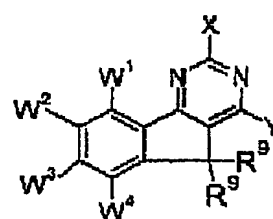
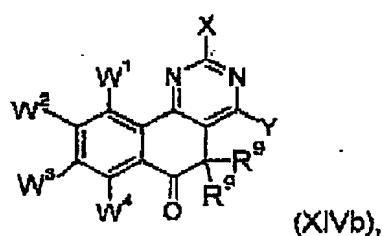
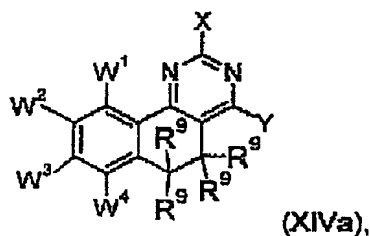


31. An electroluminescent device according to claim 9, wherein Y is , wherein  $Y^1$  to  $Y^5$  are as defined in claim 9, with the proviso that at least one of the substituents  $Y^1$  to  $Y^5$  is different from H.

57

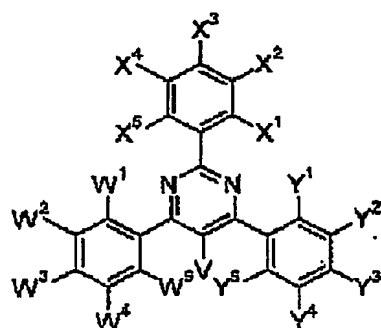


37. An electroluminescent device according to claim 9, comprising a pyrimidine compound of formula



38. A polymer, comprising the following units:

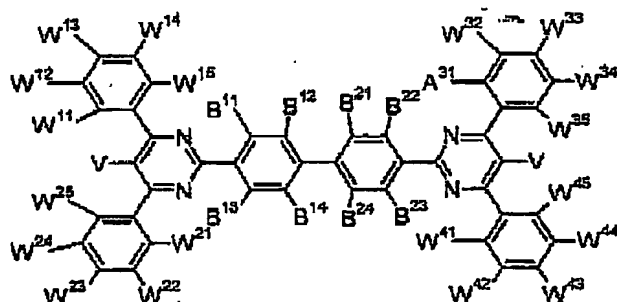
59



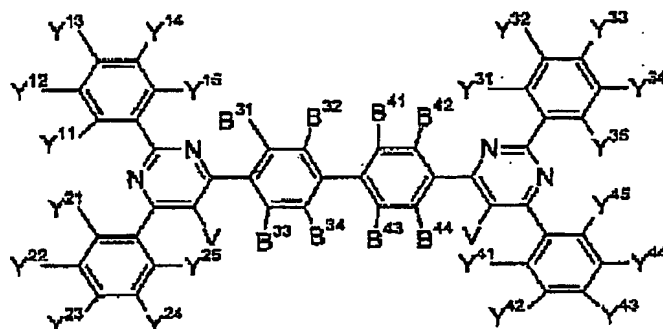
(IV), wherein

V, W<sup>1</sup> to W<sup>5</sup>, X<sup>1</sup> to X<sup>6</sup> and Y<sup>1</sup> to Y<sup>4</sup> are as defined in claim 9.

40. A pyrimidine compound of formula



(VI) or



(VII), wherein

W<sup>11</sup> to W<sup>15</sup>, W<sup>21</sup> to W<sup>25</sup>, W<sup>31</sup> to W<sup>35</sup>, W<sup>41</sup> to W<sup>45</sup>, Y<sup>11</sup> to Y<sup>15</sup>, Y<sup>21</sup> to Y<sup>25</sup>, Y<sup>31</sup> to Y<sup>35</sup> and Y<sup>41</sup> to Y<sup>45</sup> are independently of each other H; C<sub>6</sub>-C<sub>18</sub>aryl; C<sub>6</sub>-C<sub>18</sub>aryl which is substituted by G; C<sub>1</sub>-C<sub>18</sub>alkyl; C<sub>1</sub>-C<sub>18</sub>alkyl which is substituted by E and/or interrupted by D; C<sub>7</sub>-C<sub>18</sub>alkylaryl; C<sub>7</sub>-C<sub>18</sub>alkylaryl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkenyl; C<sub>2</sub>-C<sub>18</sub>alkenyl which is substituted by E and/or interrupted by D; C<sub>2</sub>-C<sub>18</sub>alkynyl; C<sub>2</sub>-C<sub>18</sub>alkynyl which is substituted by E and/or interrupted by D; C<sub>1</sub>-C<sub>18</sub>alkoxy, C<sub>1</sub>-C<sub>18</sub>alkoxy which is substituted by E and/or interrupted by D; -SR<sup>5</sup>; -NR<sup>5</sup>R<sup>6</sup>; C<sub>2</sub>-C<sub>18</sub>heteroaryl; C<sub>2</sub>-C<sub>18</sub>heteroaryl which is substituted by L; -SOR<sup>4</sup>; -SO<sub>2</sub>R<sup>4</sup>; -COR<sup>8</sup>; -COOR<sup>7</sup>; -CONR<sup>5</sup>R<sup>6</sup>; C<sub>4</sub>-C<sub>18</sub>cycloalkyl; C<sub>4</sub>-C<sub>18</sub>cycloalkyl which is substituted by



61

**ELECTROLUMINESCENT DEVICE****Abstract of the Disclosure**

Disclosed are electroluminescent devices that comprise organic layers that contain certain organic compounds containing one or more pyrimidine moieties. The organic compounds containing one or more pyrimidine moieties are suitable components of blue-emitting, durable, organo-electroluminescent layers. The electroluminescent devices may be employed for full color display panels in for example mobile phones, televisions and personal computer screens.

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